Realistic Fields for Tetra Ring Using ICOOL

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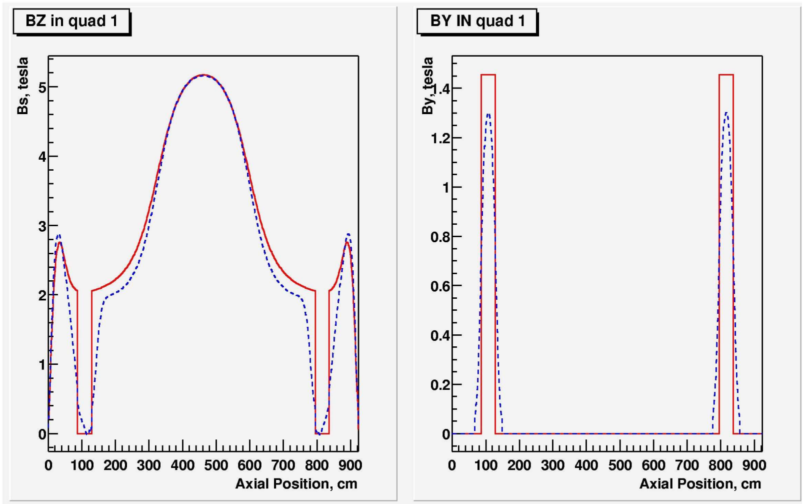
Why No Progress With Realistic Fields

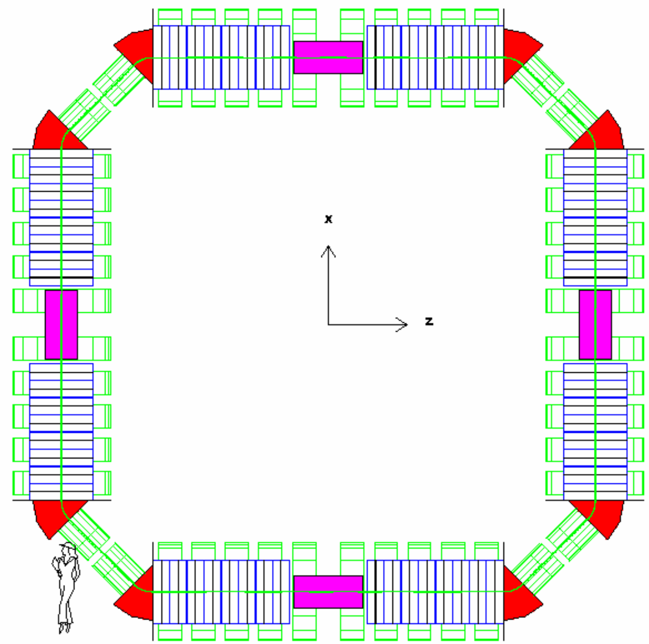
- Need to Understand the GEANT with Hardedge Fields before Attempting Realistic Fields.
  - My attempts (and others) have reported large losses in using GEANT with this simulation.
- Valeri Balbekov has shown that one can achieve a reasonable amount of cooling with reasonably good transmission through this TETRA ring.
  - Rick Fernow has similarly achieved similarly good results with a high FoM for the TETRA ring in ICOOL.



•Field maps of the solenoids have been supplied to Makino and Berz for use in their COSY model.

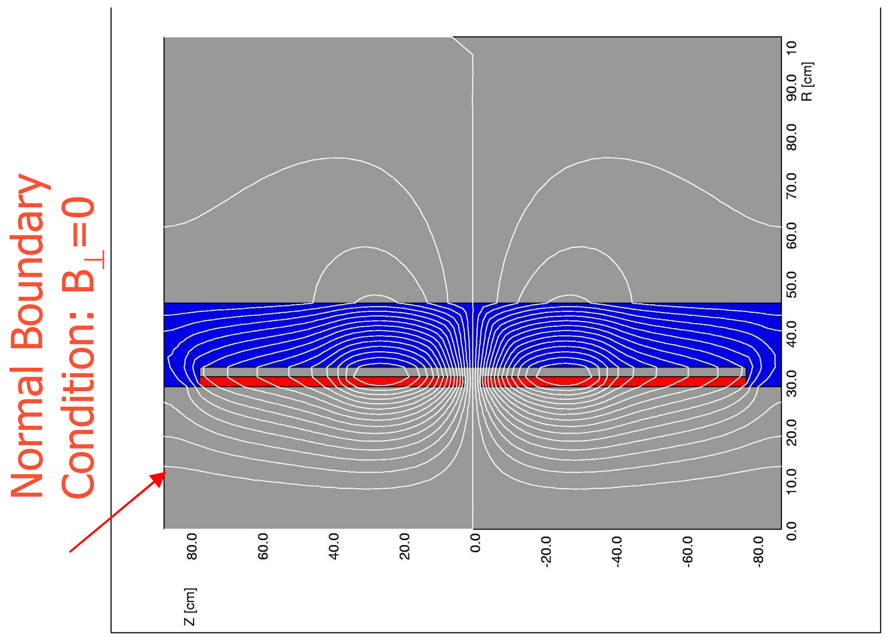
Approach to put Realistic Fields into ICOOL Tetra Ring Model

- The approach is to start with the ICOOL model of the Tetra Ring.
  - One can replace one hardedge component at a time with a more realistic representation.
  - In this initial attempt we will replace the short field flip solenoid with a more realistic field.

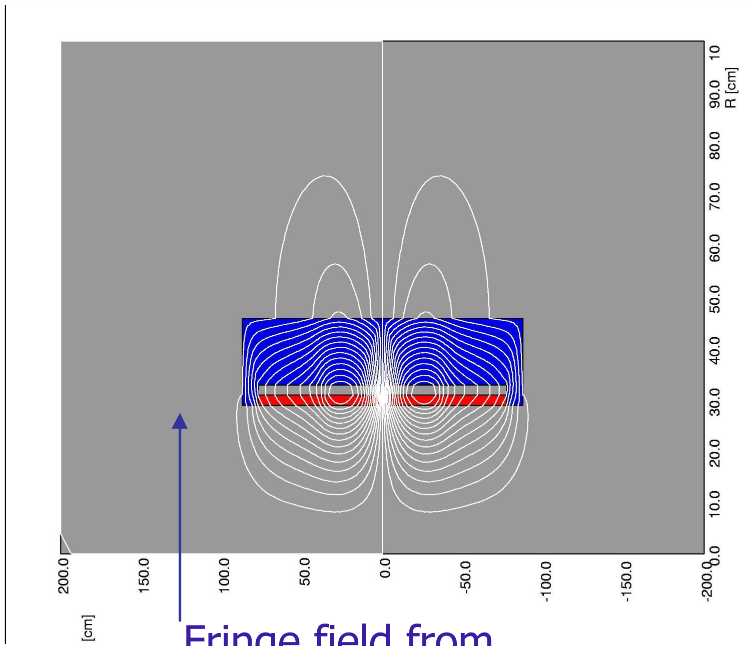


Contour Plots of Field for Field Flip Short Solenoid

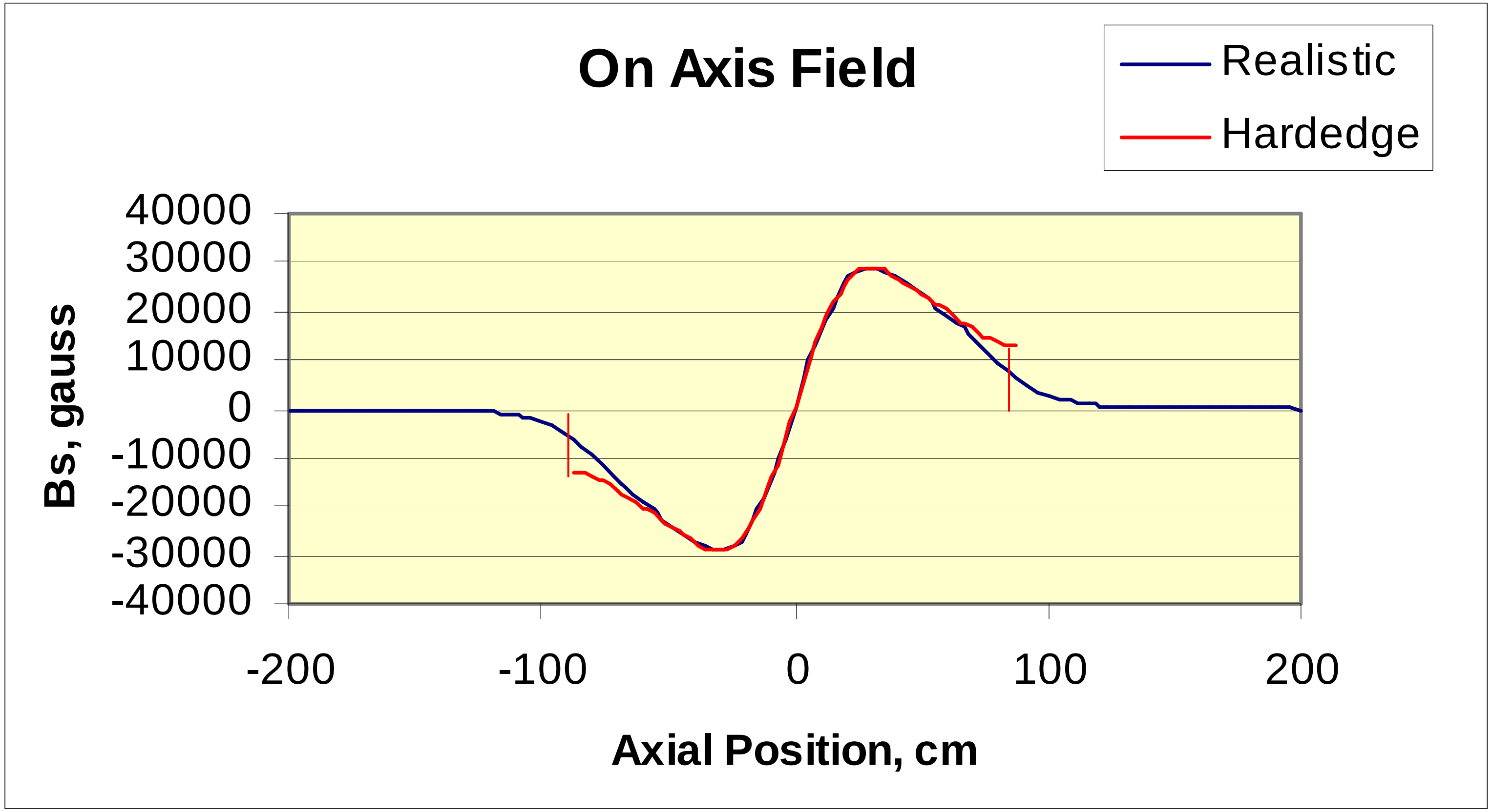
Hardedge Field Picture



Realistic Field Picture



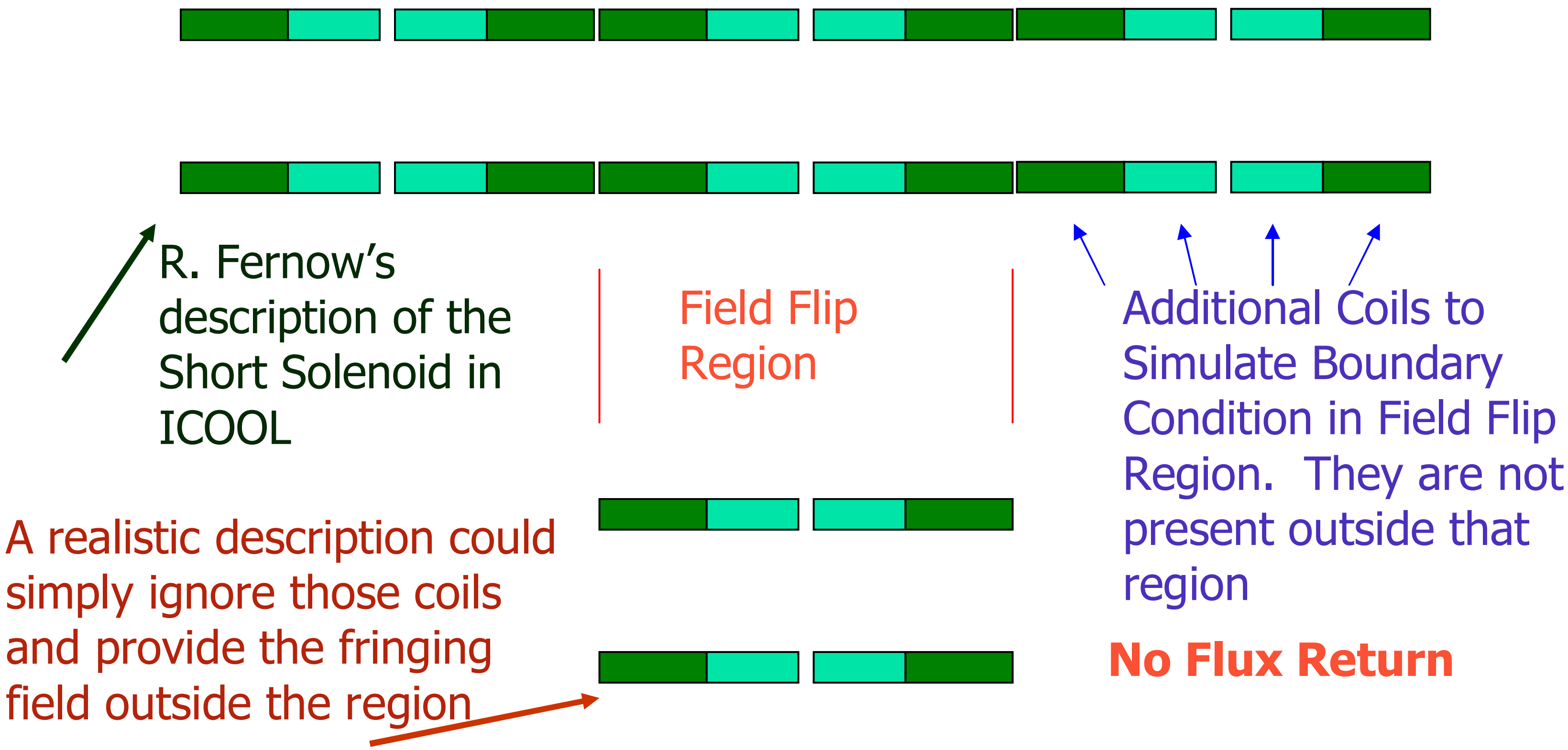
On Axis Field from Short Solenoid



Integrated Short-Solenoid Fields

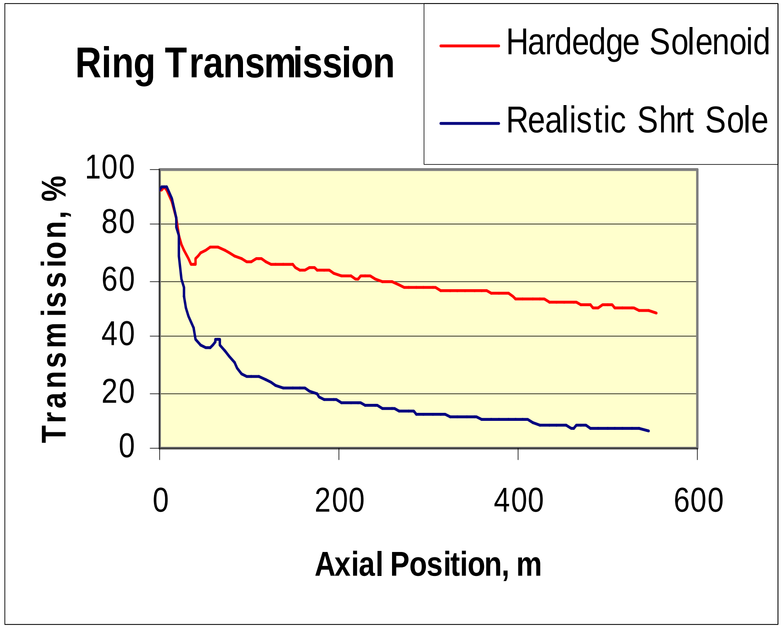
- $\int B_s dl$ in the half short solenoid is the same for the both the realistic and the hardedge case.
  - This is just Ampère's Law.
  - This is also true for the actual reference path that bends in the dipole.
- This merely says that the number of Larmor rotations is the same for the two cases.
- The focusing for a solenoid is dependent on the fringing fields. It has contributions from the $\int B_s^2 dl$ also.

Representing The Field Flip Solenoid in ICOOL



Initial Attempt

- Merely replacing the hardedge short solenoid with this realistic model with the same integrated B_s has high losses.
- This is not surprising!
- One needs to replace the short solenoid with the same transfer function.



Obtaining The Transfer Function

- One can launch 8 tracks with $x_{start}=\pm1$ cm, $y_{start}=\pm1$ cm, $p_x=\pm10$ MeV, $p_y=\pm10$ MeV, respectfully.
- We look at the transfer matrix from the start point to the entrance (M_{in}) and exit (M_{out}).
- These matrices can be rotated to the Larmor frame where x, P_x and y, P_y are separated:
  - $M_{in}' = M_{LR}^{-1} M_{in} M_{LR}$
- The transfer matrix corresponding to the Short Solenoid can be represented by:
  - $M_{ss}' = M_{in}'^{-1} M_{out}'$

Transfer Matrix (cont)

- The idea is to match the *realistic* version of the transfer matrix to the *hardedge* version of the matrix.
  - The x, Px (and y, Py) sub-matrix are dependent on three independent variables.
  - Do we have enough handles to match all 3 variables?
    - We have the integrated B_s (ie, the total current in each half).
      - It is not clear how much this can be varied.
    - We can vary the current in each coil.
    - Is this enough??